

DISTRIBUTION OF SUBSURFACE VOLATILES ACROSS THE EQUATORIAL REGION OF MARS. N.

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Background: The fluidized ejecta morphology found around most fresh martian impact craters is believed to result from impact into subsurface volatile reservoirs [1, 2], although interaction with the thin martian atmosphere may also play a role [3, 4]. A 1990 study by Barlow and Bradley [2] found that some ejecta morphologies are associated with specific diameter ranges at certain latitudes. This diameter-latitude dependence is particularly apparent for the single lobe and multiple lobe ejecta morphologies: Single lobe morphologies dominate among craters in the 8 to 25 km diameter range within the $\pm 35^\circ$ latitude zone while multiple lobe morphologies dominate among craters in the 25 to 50 km diameter range in the same location. At higher latitudes, the number of multiple lobe craters decreases dramatically and single lobe morphologies dominate at all but the very largest diameters, when the radial morphology begins to appear. The excavation depths correlate well with the proposed distribution of subsurface water versus ice proposed by geothermal models [5, 6]. Barlow and Bradley thus proposed that the ejecta-diameter-latitude results could be explained by impact into different amounts and physical states of subsurface volatiles. Single lobe craters result from excavation into ice-rich material while the multiple-lobe structures result from impact into liquid-rich reservoirs. Double lobe morphologies result from impact into layered materials with varying concentrations of volatiles and radial morphologies result from excavation into volatile-poor material.

Current Study: We are utilizing the results of the Barlow and Bradley study [2] to determine the regional variation in subsurface volatiles within the equatorial region of Mars. We are delineating $5^\circ \times 5^\circ$ latitude-longitude bins within the $\pm 30^\circ$ latitude range to determine the concentrations of craters with specific ejecta morphologies. This project utilizes the data within Barlow's *Catalog of Large Martian Impact Crater*, which was derived from the Viking Orbiter 1:2M photomosaic

series. The technique parallels that used by Barlow and Bradley: We determine two crater percentages for each ejecta morphology within the $5^\circ \times 5^\circ$ bins: 1) the percentage of all craters within the area which display the specific ejecta morphology, and 2) the percentage of craters displaying ejecta blankets which display the specific morphology. The first percentage provides information on the statistical validity of the results while the second percentage provides information on the dominant ejecta morphologies in the region. For each ejecta type, we look at how the percentages vary not only with location but also with diameter and terrain.

Status of Project and Preliminary Results: At the present time, we have completed the analysis for the regions between 0° and 30°N latitude, longitude 315°W westward to 270°W , and between 0° and 30°S latitude, 135°W to 270°W longitude. We do detect regional variations in the frequency of specific ejecta morphologies. For example, we have found that the double lobe ejecta morphology, although normally quite rare within the $\pm 30^\circ$ latitude region, make up a larger percentage of ejecta craters in the region bounded by 20°N to 30°N latitude, 50°W to 90°W longitude. This area corresponds with the depositional regions of several outflow channels, including Kasei Valles. Double lobe craters are proposed to occur by impact into layered materials where the layers contain varying amounts of volatiles. One would expect that sedimentary deposits would produce such layered deposits, and if such deposits were laid down at different time periods they could well contain different amounts of volatiles. These results are consistent with those of Demura and Kurita [7] and Costard et al. [8] who also found evidence from crater studies that the Kasei Valles region is volatile-rich.

We also have found that multiple lobe craters make up a larger percentage of ejecta craters in the region bounded by 0° to 25°N and 315°W to

10°W longitude. This area corresponds to an region of heavily cratered terrain which includes the proposed hematite deposit recently announced by the Mars Global Surveyor TES instrument team [9]. Hydrothermal activity has been proposed to explain this hematite deposit, which would be consistent with the concentration of multiple lobe craters in this area since multiple lobe morphologies are proposed to occur from impact into liquid-rich reservoirs.

Throughout all the areas we have studied, the single lobe ejecta morphology is the most prevalent. The single lobe morphology was proposed by Barlow and Bradley to result from impact into ice. The prevalence of single lobe ejecta craters across our study area indicates that subsurface ice is distributed throughout this region at the depths corresponding to the excavation depths of these craters (generally 0.5 km and greater). However, one exception to this general trend is found in the Tharsis volcanic region. Although the region is sparsely cratered, the majority of craters in this region display the radial ejecta pattern, indicative of impact

into volatile-poor materials. The predominance of radial ejecta patterns around craters of the same size which elsewhere display single lobe morphologies indicates that the volcanic materials in the Tharsis region are significantly drier to a greater depth than materials elsewhere within the martian equatorial region.

References: [1] Carr, M. H., et al (1977), *J. Geophys. Res.*, **82**, 4055-4065. [2] Barlow, N. G. and T. L. Bradley (1990), *Icarus*, **87**, 156-179. [3] Schultz, P. H. and D. E. Gault (1979), *J. Geophys. Res.*, **84**, 7669-7687. [4] Schultz, P. H. (1992), *J. Geophys. Res.*, **97**, 16183-16248. [5] Fanale, F. P. (1976), *Icarus*, **28**, 179-202. [6] Clifford, S. M. (1993), *J. Geophys. Res.*, **98**, 10973-11016. [7] Demura, H. and K. Kurita (1998), *Earth Planets Space*, **50**, 423-429. [8] Costard, F., J. P. Peulvast, and P. Masson (1998), Mars Surveyor 2001 Landing Site Workshop. [9] Christensen, P., Press Release from AGU Meeting, May 27, 1998.